

REMARKS/ARGUMENTS

Claims 1-11 are pending in the application. Claims 11-14 are withdrawn from further consideration by the Examiner. In this response, claim 1 is amended to more clearly recite applicants' process. As amended, the claim now incorporates the subject matter originally contained in claims 5 and 7, together with additional technical features calculated to further distinguish claim 1, together with the claims which depend from that claim, from the prior art cited in the Office Action. The claim amendments are entirely supported by the application as originally filed. Thus, there is no issue of new matter. Further, claims 5 and 7 have been canceled without prejudice or disclaimer. Additionally, new claims 16-18 are added to the application. The new claims are supported by the application as filed and, therefore, they also add no new matter to the application.

Upon entry of this Amendment, claims 1-4, 6 and 8-11, as well as new claims 16-18 will be pending in the application. Claims 12 - 15 remain withdrawn from further consideration.

Comments

The Examiner's proposals for amending claim 5 on p. 2 of the Office Action are noted. However, it is respectfully submitted that the cancellation of the subject claim, without prejudice or disclaimer, renders those proposals moot.

Claim Rejections Under 35 U.S.C. §103

Claims 1-3 and 6-11 are rejected under 35 U.S.C. §103 as being allegedly unpatentable over USP 6,136,062 to Loffelholz, et al. in view of USP 5,417,917 to Takahar, et al. for the reasons set forth on p. 3 of the Office Action. In addition, claim 4 is rejected under §103 over the combination of Loffelholz, et al. and Takahar, et al. and further in view of USP 3,839,020 to Honma, et al. (see p. 3 of the Office Action and p. 5 of the Office Action dated February 5, 2007). Still further, claim 5 is rejected under §103 over the combination of Loffelholz, et al. and Takahar, et al. and further in view of USP 6,015,527 to Kamei, et al. (see p. 4 of the Office Action and pp. 5-6 of the February 5, 2007 Office Action). These rejections are respectfully traversed.

Both Loffelholz, et al. and Takahar, et al. are extensively discussed in applicants' prior response dated June 5, 2007 and those prior comments are specifically incorporated herein by reference.

In response to the Examiner's remarks at pp. 3-5 of the present Office Action, applicants have amended claim 1 such that it now recites a metal powder production process using a metal compound as a raw material and reducing the metal compound, wherein the process comprises: a molding step in which the metal compound is mixed with a binder and a reaction agent, is molded, and is sintered to produce a metal compound feed compact; and a reducing step in which a metal is formed by reducing the metal compound feed compact by contacting the metal compound feed compact with an active metal reducing agent, wherein, in the reducing step the active metal is arranged at a distance from the metal compound feed compact and [is] vaporized by heating so that the vaporized active metal is supplied to the metal compound feed compact; and the reaction agent is at least one compound of an active metal selected from calcium, magnesium, sodium, barium and potassium. [Note: the underlined portions above have been added to claim 1 by amendment in this response].

As now amended, claim 1 and the claims depending therefrom are believed to be further distinguishable over the cited combination of references based, *inter alia*, on the reasons presented herein.

Whereas the Examiner apparently believes that it would be 'obvious' to one having an ordinary degree of skill in this art to modify the teachings of Loffelholz, et al. along the lines disclosed in Takahar, et al. and/or Honma, et al. and/or Kamei, et al., applicants respectfully submit that there is no motivation found in any of these references which would lead a skilled artisan in this field toward such a combination as postulated in the Office Action. This lack of motivation is, at least in part, attributable to the significant difference(s) in the objective, i.e., the problem to be solved, encountered in each of the references.

To begin with, the Loffelholz, et al. reference states, in the discussion relating to the "Field and Background of the Invention", that in the reduction of heavy metal oxides by alkaline earth metals or hydrides, the control of the reduction reaction is difficult (see, e.g., Col. 1, lines 26-28). Thus, Loffelholz, et al. have developed a two-stage reduction process in an effort to overcome these difficulties.

Takahar, et al., on the other hand, discloses a method for producing an open cell, porous metallic material, which is applicable to filters, electrodes for fuel cells and the like. The Takahar, et al. reference states, in the discussion relating to the “Background of the Invention”, that utmost care is required for manufacturing the metallic porous membrane, and that the cost is expensive because a metal powder with a small particle diameter is needed. Takahar, et al. have thus developed a novel method for overcoming the above-described disadvantages.

Honma et al., which is combined with Löffelholz and Takahar to reject claim 4, discloses a process for producing an alloy sponge of titanium or a zirconium base metal by admixing a halide of an additive alloy element with titanium tetrachloride or zirconium tetrachloride, and thereafter reducing both simultaneously with a metallic alkali. This method, as well as its object, differs significantly from those taught in both Löffelholz et al. and Takahar et al. (see above).

The Kamei et al. reference, combined with Löffelholz, et al. and Takahar, et al. to reject claim 5 for obviousness, states in the “Background Technology” that the invention described therein is intended to provide a method for production of reduced iron in a simple and inexpensive way in place of the conventional pelletizing method, and further, to provide a method of producing high quality hot metal efficiently and at a low cost through a simple process using reduced iron obtained as above. As is the case with regard to Honma, et al. mentioned above, the method of Kamei, et al., as well as its object, differs significantly from those taught in both Löffelholz et al. and Takahar et al.

Further to the above, even if one does not take into account the lack of teaching or suggestion to combine the cited references in view of the differences in the problems they are each designed to solve, applicants respectfully submit that there are significant differences, described below, between the presently claimed process and the methodologies described in each of the cited references such that none of these references, taken by itself nor in any combination, would teach or suggest the process as now recited in, for example, independent claim 1 of the present application.

Claim 1, as now amended, recites that, “in the reducing step, the active metal is arranged at a distance from the metal compound feed compact and vaporized by heating, so that the vaporized active metal is supplied to the metal compound feed compact”.

The Examiner indicated in the Office Action that because the reducing temperature of the Löffelholz, et al. reference overlaps the claimed reducing temperature range, the vapor pressure

of magnesium in the reducing system thereof would be similar to that in the reducing system of the presently claimed process. However, even if this is so, in the reducing system of Löffelholz, et al. essentially only the liquid magnesium is supplied to the metal compound feed compact to reduce the metal compound, while the vaporized active metal is supplied to the metal compound feed compact to perform the reducing reaction in the present reducing system. Specifically, in the case of the presently claimed process the active metal is arranged at a distance from the metal compound feed compact to perform the reducing reaction. By virtue of this feature, the active metal can more uniformly diffuse in the reaction vessel in which the feed compacts are arranged and can more sufficiently contact the metal compound feed compact, without a stirring operation, thereby increasing the efficiency of the reducing reaction. In contrast, in the reducing system of Löffelholz, et al., a stirring operation is required to mix the liquid Mg and the niobium oxide.

As evidence of the above, an Experiment 1 was carried out by the applicants as illustrated in Fig.1(A) attached hereto, wherein the result is shown in Fig. 2. This result indicates that uniform metal powder is obtained from the process according to the presently claimed process having the technical feature discussed above, i.e., wherein, “in the reducing step, the active metal is arranged at a distance from the metal compound feed compact and vaporized by heating, so that the vaporized active metal is supplied to the metal compound feed compact”.

The Examiner additionally noted in the Office Action that applicants’ arguments made in the previous response, i.e., that the metal powder produced by the method of Löffelholz, et al. is not uniform and would be contaminated, cannot be relied upon as evidence. In support of applicants’ arguments, therefore, Experiment. 2 was carried out as illustrated in Figs.1(A,B) attached hereto. The experimental conditions are detailed in Table 1 and the results of the experiment are illustrated in Figure 2. As shown in Table 1, the impurity content of tantalum powder obtained from Experiment 2(B) is significantly larger than that obtained from Experiment 2(A).

This result indicates that if the raw material including the metal compound and the reduction agent contacts the reaction container in a large area, the metal powder thus obtained is more easily contaminated by the reaction container. Therefore, it is clear that when using liquid Mg, because of the stirring operation, the liquid Mg contacts the inside wall of the reaction container more frequently and therefore the contamination occurs more easily. In other words, having the technical feature, “in the reducing step, the active metal is arranged at a distance from

the metal compound feed compact and vaporized by heating, so that the vaporized active metal is supplied to the metal compound feed compact” serves to more effectively reduce the contamination caused by the reaction container.

As to the experimental data discussed above, applicants would have no objection to re-submitting their experiments and the results obtained thereby in the form of a Declaration under 37 C.F.R. 1.132 if requested by the Examiner.

Further to the above, Claim 1 as amended also recites an additional technical feature, which is that, “the reaction agent is at least one compound of an active metal selected from calcium, magnesium, sodium, barium and potassium”.

The Examiner continues in the present Office Action to maintain that the reaction agent of the present invention corresponds to the powdery reductant of Kamei et al. However, the reaction agent now specifically recited in Claim 1 as amended is at least one compound of an active metal selected from calcium, magnesium, sodium, barium and potassium. These are completely different from the powdery reductants disclosed in the Kamei et al. reference, which include such as coal, charcoal, petroleum cokes and cokes.

In the case of the presently claimed process, the reaction agent is used as a reduction assistant and the reaction agent is apparently unchanged before and after the reducing reaction. For example, when using CaO as the reaction agent, the CaO reacts with the metal compound feed compact (NbO_x) to produce a complex oxide (CaNb_xO_y), whereupon the complex oxide is reduced by the reducing agent to produce Nb and CaO. In this manner, CaO is apparently unchanged following the reducing reaction. Also, for example, when CaCl_2 is used as a reaction reagent, the CaCl_2 is melted at the reducing temperature to dissolve the active metal oxide produced by the reducing reaction. Thus, in the above manner CaCl_2 is neither reduced nor oxidized by the reduction reaction.

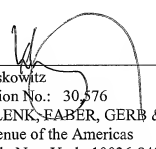
Since the metal compound feed compact includes the reaction agent as an essential component, the morphology of deposit of the metal powder can be more effectively controlled and thereby the reducing reaction proceeds more uniformly, coupled with an increase in the production efficiency and the acid treatment efficiency (see, e.g., the paragraph bridging pp. 6-7 of the present application). In addition, due to the fact that the reaction agent also works as a binder, a relatively high strength of the metal feed compact can be maintained even after the reducing reaction and the shape of the feed compact is also nearly maintained even after the

reducing reaction. This permits easy handling of the metal compound feed compact when undergoing the acid treatment step (see, e.g., specification p. 8, lines 12-16). In contrast, in the system described in the Kamei, et al. reference, the powdery reductant is used for reducing the iron oxide and the powdery reductant itself is oxidized following the reducing reaction. This demonstrates that the reacting agent of the presently claimed process is entirely different from the powdery reductant described in Kamei, et al. and that the effects of the reaction agent in the presently claimed process can not be obtained through the use of the powdery reactant of Kamei, et al.

Consequently, for the reasons above, the technical features of the invention as recited, e.g., in applicants' amended independent claim 1 are neither taught nor suggested in any of the cited references, whether those references are taken individually or in any combination. The Examiner is, therefore, respectfully requested to reconsider and withdraw the rejection of claim 1. Moreover, since the remaining claims all depend, directly or indirectly on the independent claim and thus contain all of the features recited in the subject claim, those claims are all believed to be distinguishable for the same reasons as claim 1. Thus the rejection of those claims should also be withdrawn.

Respectfully submitted,

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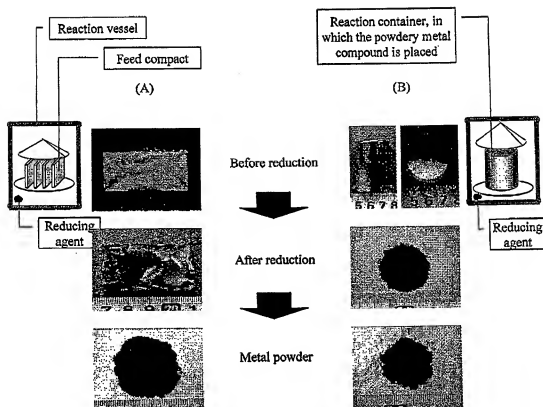


Fig.1 Schematic illustration of the experiments.

- (A) the powdery metal compound is mixed with a binder, then molded to a feed compact, and then the feed compact is placed in a reaction vessel to perform the reducing reaction;
- (B) the powdery metal compound is placed in a reaction container without molding to a feed compact to perform the reducing reaction.

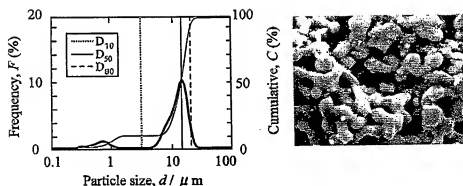


Fig. 2 Particle size distribution of the niobium powder obtained from the Exp.1(A), and SEM image of the powder.

Experimental conditions of Exp.1:

Exp.1(A) was carried out as illustrated in Fig.1(A).

Raw material: Niobium oxide

Reduction reaction: $T_{\text{red.}} = 1273 \text{ K}$, $t'_{\text{red.}} = 24 \text{ h}$

Reaction agent: CaCl_2

Table 1. Results of EDS analysis of tantalum powder obtained in Exp.2

No.	Raw material	Ta (mass%)	Impurity contents (mass%)				
			Mg	O	Fe	Ni	Cr
Exp.2(A)	Ta_2O_5	99.0	0.20	(0.62)	0.15	0.00	0.04
Exp.2(B)		91.1	0.19	(1.10)	2.99	3.15	1.48

Experimental conditions of Exp.2:

Exp.2(A) and 2(B) were carried out as illustrated in Fig.1(A) and 1(B) respectively.

Reduction reaction: $T_{\text{red.}} = 1273 \text{ K}$, $t'_{\text{red.}} = 6 \text{ h}$, $t_{\text{cool}} = 20 \text{ s}$

Values in paranthesis are listed for reference.